

1 TCP OPTICAL DEVICE

2
3 FIELD OF THE INVENTION

4 The present invention is relating to an optical device with a tape, particularly to an
5 optical device in a tape carrier package type with inner lead bonding.

6 BACKGROUND OF THE INVENTION

7 It is familiar that the optical device includes a properly protected optical sensor chip,
8 generally the optical sensor chip being installed in a ceramic board with a recession,
9 furthermore being sealed by a transparent glass cover, however the space for sealing the
10 optical sensor chip generally being vacuum or filling with inert gas so as to prevent
11 seeping vapor, thus this ceramic-packaging cost is high.

12 In order to decrease the packaging cost for optical device, a CCD package of image
13 sensor element is disclosed in U.S. Patent No. 6,011,294 "low cost CCD packaging". As
14 shown in Fig. 6 and 7, The CCD package 10 includes a plastic base 12, a plastic ring
15 frame 14 and a glass cover 16 to form a hermetic space. The glass cover 16 is used to seal
16 the optical sensor chip 11 being on the topside surface 24 of plastic ring frame 14. A
17 flexible circuit 18 located between plastic base 12 and plastic frame 14 has the
18 conductive leads 19 which are on the substrate 20. The optical sensor chip 11 is adhered
19 onto the upside surface of flexible circuit 18 and electrically interconnects with the
20 flexible circuit 18 by the bonding wires 29. However, there is a defect that the optical
21 sensor chip 11 is directly adhered to the flexible circuit 18 without a fixed base, therefore
22 the stability is worse resulting in level precision deviating and horizontal displacement of
23 optical sensor chip 11, seriously influencing the angle and position of optical sensation.
24 Moreover, if flexible circuit 18 is wider than plastic base 12 for width, the flexible circuit
25 18 is adhered to plastic base 12 and plastic frame 14 by its underside surface and its
26 upside surface respectively, resulting in a worse sealing.

27 SUMMARY

1 The first object of the present invention is to provide an optical device with a tape,
2 comprising a molded base to carry optical sensor chip and fix the flexible circuit board,
3 the optical sensor chip then being stably fixed on the base to achieve lower cost
4 packaging and better stability for an optical device.

5 The second object of the present invention is to provide an optical device with a tape,
6 comprising a flexible circuit board which has metal circuits. The inner leads of metal
7 circuits are connected with optical sensor chip by thermal compression and all outer leads
8 of metal circuits are extended to same side, so that it is not necessary to surface-mounting
9 to printed circuit board for quick assembling and wide adjustable range for an optical
10 device.

11 The third object of the present invention is to provide a TCP packaging method for
12 an optical device, by means of thermal compression to electrically connect flexible circuit
13 board with optical sensor chip, and then molding the base for carrying optical sensor chip,
14 an optical device with low cost packaging and better stability is achieved.

15 The optical device with a tape carrier packaging according to the present invention
16 comprises:

- 17 an optical sensor chip having a plurality of electrodes on its sensible surface;
- 18 a flexible circuit board having an upside surface, an underside surface and a window
- 19 wherein the underside surface around the window is adhered to the perimeter of the
- 20 sensible surface of the optical sensor chip;
- 21 a plurality of metal circuits formed on the flexible circuit board, their inner leads
- 22 extending to the window for bonding with the corresponding electrodes of optical
- 23 sensor chip;
- 24 a base having a recession and a surrounding dam, wherein the recession located
- 25 under the underside surface of the flexible circuit board accommodates optical
- 26 sensor chip and is corresponding to the window, the surrounding dam extends onto
- 27 the upside surface of flexible circuit board; and

1 a transparent cover connecting with the surrounding dam for sealing the optical
2 sensor chip.

3 DESCRIPTION OF THE DRAWINGS

4 Fig. 1 is a sectional view of an optical device with a tape carrier package according
5 to the first embodiment of the present invention.

6 Fig. 2 is a top view of the optical sensor chip connected with the tape of flexible
7 circuit board according to the first embodiment.

8 Fig. 3 is a perspective view of folding portable telephone using the optical device
9 with a tape carrier package according to the first embodiment.

10 Fig. 4 is a sectional view of an optical device with a tape carrier package according
11 to the second embodiment of the present invention.

12 Fig. 5 is a sectional view of an optical device with a tape carrier package according
13 to the third embodiment of the present invention.

14 Fig. 6 is a sectional side view of a CCD package disclosed in U.S. Patent No.
15 6,011,294 "low cost CCD packaging".

16 Fig. 7 is a top view of a CCD package disclosed in U.S. Patent No. 6,011,294 "low
17 cost CCD packaging".

18 DETAILED DESCRIPTION OF THE PRESENT INVENTION

19 Referring to the drawings attached, the present invention will be described by means
20 of the embodiments below.

21 According to the optical device with a tape carrier package for the present invention,
22 in the first embodiment, Fig. 1 is a sectional view of the optical device 100 with a tape
23 carrier package and Fig. 2 is a top view of the optical device 100 with a tape carrier
24 package prior to molding.

25 The optical device 100 with a tape carrier package mainly comprises a flexible
26 circuit board 110, an optical sensor chip 130, a base 140 and a transparent cover 150,
27 wherein the optical sensor chip 130 is a charge coupled device, photodiode, infrared

1 sensor element or image sensor element, having a sensible surface used to sense, and
2 forming a plurality of gold bumps 131 on the sensible surface for being the electrodes of
3 optical sensor chip 130 and are used to bond with the inner leads 121 of metal circuits
4 120 on the flexible circuit board 110.

5 The flexible circuit board 110 is made from a tape with a polyimide flexible material,
6 can be rolled in a reel. The flexible circuit board 110 has a single-layer or multi-layers
7 structure, in this embodiment illustrating is a single-layer circuit board. The flexible
8 circuit board 110 has an upside surface 111, an underside surface 112 and a window 113
9 corresponding to the optical sensor chip 130, in this embodiment for size the window 113
10 is a little smaller than optical sensor chip 130. A plurality of copper metal circuits 120 are
11 formed on the upside surface 111, each metal circuit 120 has an inner lead 121 and an
12 outer lead 122, the inner lead 121 extending to the window 113 mentioned above and
13 being bonded with the corresponding electrode 131 of optical sensor chip 130 by thermal
14 compression, the outer leads 122 of metal circuits 120 extending to a same direction and
15 connecting to an electrical plug. Besides, the flexible circuit board 110 further forms a
16 plurality of openings 114 around the window 113 used to enable the thermosetting plastic
17 filler to flow and fixed holes 115 with regular interval at the two sides of tape of flexible
18 circuit board 110 for transmission, and there is at least a defined molding area 116 (as
19 shown in Fig. 2) to be an area for molding the base 140. Moreover, there is adhesive
20 compound 132 like thermal melting compound formed on the underside surface 112 of
21 flexible circuit board 110 around the window 113 so as to adhere the perimeter of upside
22 surface of optical sensor chip 130.

23 The base 140 is formed by the technique of molding and injection filling the
24 foregoing molding area 116 with thermosetting plastic. The base 140 has a recession 141
25 used to accommodate optical sensor chip 130 and located under the underside surface 112
26 of flexible circuit board 110 corresponding to the window 113, and a surrounding dam
27 142 extending onto the upside surface 111 of flexible circuit board 110 and fixedly

1 attaching a transparent cover 150 of glass material by the methods of adhering, thermal
2 sealing, ultrasonic or laser bonding etc. In this embodiment, the transparent cover 150 is
3 adhered by adhesive compound 151 of thermal melting compound to the recession
4 formed at the upside of the surrounding dam 142, using transparent cover 150 and base
5 140 to seal the optical sensor chip 130, generally filling the hermetic space between
6 transparent cover 150 and base 140 with inert gas of low humidity like nitrogen or argon,
7 or becoming vacuum.

8 The optical sensor chip 130 is carried and fixed by the hard base 140 so that has a
9 better stability in hermetic space after packaging. Therefore, the optical device with a
10 tape carrier package has not only lower cost packaging (replacing of ceramic board) but
11 also better quality, uneasy for level precision deviating and horizontal displacement.
12 Meantime, the outer leads 122 of metal circuit 120 are used to be output ends of the
13 optical device 100, then no need for surface mounting. By the way the image sensor
14 device like optical device 100 can be installed in a folding portable telephone (as shown
15 in Fig. 3) or other portable electronic product reaching a quick assembling and wide
16 adjustable range. Comparatively, the conventional optical device must execute surface
17 mounting or insert on a printed circuit board first, and using the flexible flat cable to lead
18 the output end out. The optical device 100 obviously avoids a troublesome assembly
19 process and occupies a smaller space.

20 The tape carrier packaging method of foregoing optical device is described below:

21 A tape is provided ,being a flexible circuit board, with an upside surface 111, an
22 underside surface 112 and a plurality of windows 113. A plurality of metal circuits 120 are
23 formed on the upside surface 111. Each metal circuit has a inner lead 121 extending to the
24 windows 113.

25 At least an optical sensor chip 130 is provided with a plurality of electrodes 131
26 being formed on the sensible surface of each optical sensor chip 130.

27 Thereafter, the inner leads 121 of metal circuits 120 are bonded by thermal

1 compression with the electrodes 131 of optical sensor chip 130 through the windows 113.
2 Besides, the underside surface 112 of the tape around the window 113 is adhered to the
3 perimeter of the sensible surface of the optical sensor chip 130 by adhesive 132 or tape.

4 A base 140 is formed, such as molding having a recession 141 used to accommodate
5 optical sensor chip 130. The recession 141 is located under the underside surface 112 of
6 flexible circuit board 110 and is corresponding to the window 113. The base 140 has a
7 surrounding dam 142 (through the opening 114 of flexible circuit board 110). The
8 surrounding dam 142 extends onto the upside surface 111 of flexible circuit board 110.

9 A transparent cover 150 is fixedly attached to the surrounding dam 142 of the base
10 140.

11 In the second embodiment of the present invention, as shown in Fig. 4 another
12 optical device 200 with a tape carrier package is illustrated. The optical device 200
13 comprises a flexible circuit board 210, an optical sensor chip 230, a thermosetting filler
14 240 and a transparent cover 250. The optical sensor chip 230 has a plurality of electrodes
15 231 formed on the sensible surface. The flexible circuit board 210 has an upside surface
16 211, an underside surface 212 and a window 213. A plurality of metal circuits 220 are
17 formed on the upside surface 211. Each metal circuit 220 has an inner leads 221
18 extending to the window 213 such that it electrically connects the electrodes 231 of
19 optical sensor chip 230 and an outer lead 222. Preferably, all outer leads 222 extend to a
20 same side. Besides, the optical device 200 further comprises adhesive compound 232,
21 251 like thermal melting compound or adhesive tape, wherein the adhesive compound
22 232 is used to adhere the underside surface 212 of flexible circuit board 210 and the
23 optical sensor chip 230, and the adhesive compound 251 is used to adhere the upside
24 surface 211 of flexible circuit board 210 and the transparent cover 250 for providing
25 necessary adhesion in the manufacturing process. Thereafter a liquid thermosetting filler
26 240 is formed around the perimeter of the chip 230 by the potting technique. During
27 potting, the liquid thermosetting filler 240 is blocked around the sensible surface of the

1 optical sensor chip 230 and flows through the opening of flexible circuit board 210 to the
2 surrounding gap between transparent cover 250 and flexible circuit board 210, then being
3 baked and cured. The thermosetting filler 240 effectively bonds the transparent cover 250
4 and the flexible circuit board 210 for sealing the optical sensor chip 230 in the window
5 213, so that the optical device 200 not only can be packaged at lower cost but also has a
6 better stability and sealing due to a stable bonding strength between optical sensor chip
7 230 and flexible circuit board 210 by means of adhesive compound 232, 251 and
8 thermosetting filler 240.

9 In the third embodiment of the present invention, as shown in Fig. 5, an optical
10 device with a tape carrier package is illustrated, wherein if the elements as same as used
11 in the second embodiment their elements number will still be used in this embodiment.
12 The optical device comprises a flexible circuit board 210, an optical sensor chip 230, a
13 thermosetting filler 240 and a transparent gel 260. A plurality of electrodes 231 are
14 formed on the sensible surface of optical sensor chip 230. The flexible circuit board 210
15 has an upside surface 211, an underside surface 212 and a window 213. A plurality of
16 metal circuits 220 are formed on the upside surface 211 and have their inner leads 221
17 extending to the window 213 for bonding the electrodes 231 of optical sensor chip
18 230 and their outwardly-extending outer leads 222. Besides, the optical device 200 further
19 comprises an adhesive compound 232 such as thermal melting compound or adhesive
20 tape around the window 232. The adhesive compound 232 bonds by adhering the
21 underside surface 212 of flexible circuit board 210 and the optical sensor chip 230 for
22 blocking the thermosetting filler 240 flowing into the sensible surface of optical sensor
23 chip 230. After thermal compression, the thermosetting filler 240 is formed on the
24 underside surface 212 of flexible circuit board 210 in the first molding process and covers
25 the backside of optical sensor chip 230 to form a carrying base. The transparent gel 260 is
26 a thermosetting silicon gel of high transparency, by the second molding process being
27 formed on the sensible surface of optical sensor chip 230. Therefore, the optical device

1 has lower cost packaging, better stability and sealing for the optical sensor chip.

2 The above description of embodiments of this invention is intended to be illustrative
3 and not limiting. Other embodiments of this invention will be obvious to those skilled in
4 the art in view of the above disclosure.

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